# Cognitive Assistants and Intelligent Agents - Keynote Speech

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**ABSTRACT**
Cognitive Assistants are a relatively new concept, advancing the Cognitive Orthotics concept that focuses on direct assistance to people with cognitive or physical disabilities and expanding the area to include complex platforms that include sensors, actuators, interfaces, monitoring abilities, and decision processes. CA is an area containing technologies such as personalized intelligent assistants, multi-agent systems, robotics, e-health applications, and others. This keynote will present several advances made in the area of CA from the point of view of intelligent agents.

**Author Keywords**
Cognitive Assistant, Multi-Agent Systems; Edge-AI; Agent-Based Simulation

**ACM Classification Keywords**
H.5.2. Information interfaces and presentation (e.g., HCI): User Interfaces.

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**INTRODUCTION**
Cognitive Assistants (CA) [1] is defined as a subset area of Personal Assistants focused on ubiquitous and pervasive platforms and services. CA are mainly aimed at elderly people's needs, habits, and emotions by being dynamic, adaptive, sensitive, and responsive. But their use can be extended to other areas related to offering help services to users. The latest advances achieved in the area of cognitive assistants make them a true candidate for being used in real scenarios and helping people (mainly elderly) at home and outside environments. The term Personal Assistants (PA) originated from the Ambient Assisted Living (AAL) area that encompasses the advances in the ICT area that are focused in providing direct care on activities of daily living and related tasks. The AAL area focuses on technologies that provide healthcare, rehabilitation, and assistance to disabled people (with cognitive and physical impairments) or the elderly. Thus, it promotes independent living, active aging, and aging in place. Therefore, the need for the distinction is required due to the fact that not all PA technologies belong to AAL and vice-versa. Recently PA has gained traction, and there are several projects with interesting results.

Numerous researchers have addressed the role of Cognitive Assistants. Pransky [2] introduces an interesting perspective on the different profiles that this type of companion could adopt in the form of robots. In one of his perspectives, Pransky raises the possibility of a "robot nanny". This robot would perform tasks such as playing with the child, feeding the child, etc., but, on the other hand, it would make the child have no human interaction at all and see interaction with the robot as the "norm". In addition to providing companionship to the elderly, the CA may have other functionalities. It can be related to supporting independent living, such as basic activities like eating, bathing, toileting, and dressing. They can also be used to monitor people who need continuous care, helping to maintain physical and psychological safety. The latter is perhaps one of the most relevant tasks that CA could have in the future.

In parallel, Intelligent Agents [3] have been used in many areas where it is necessary to develop distributed intelligent systems, where the decision-making capacity is distributed because not all the available information is available in a single place. In this sense, Intelligent agents seem to be a perfect fit for the development of cognitive assistants since they allow us to design autonomous entities with the capacity to interact with users, but at the same time interconnected with other entities (other agents) that allow us to offer more complex, flexible and integrated solutions. Research projects on this line allow moving towards an interconnected system that is able to be coordinated with other services and create an extended technological environment [4]. This environment will be greater than the sum of the parts due to the possibility of data and sensor fusion, thus making available more complex information that otherwise was unavailable. As a toy example, we can take two agents controlling each one a different sensor that, when not unified, could bring a lot of problems. These sensors are the smoke and flood detection; if there is a fire, the sprinklers will be activated, then the flood sensor will be activated and stop the sprinklers, thus allowing the fire to spread; this process would be in cycle until one of the sensors stopped working. Therefore, with this example, we can observe that interconnected agents can build interesting information when working together. in a coordinated way. This is precisely the idea of intelligent agents or multi-agent systems.

**RELATED WORKS**

The increase in life expectancy and population's aging are devastatingly affecting public administrations that look after

the welfare of this population, mainly due to the lack of healthcare personnel. One of the applications of particular interest, both at the research and commercial level, are cognitive assistants in the shape of companion robots. These companion robots, capable of assisting older adults in their daily tasks [5], keeping them company [5], organizing their activities [6], and monitoring their medication [7], and cognitive activities [8], are being widely marketed to individuals or senior centers. Several studies have demonstrated the applicability of CA for elderly care. It is possible to find assistants for almost all tasks associated with caregiving. Many of these assistants are used as companion robots; MARIO [9] is an example of a social robot developed with and for people with dementia. MARIO promotes social connectivity and reduces loneliness and isolation by providing access to various applications with which they can interact via voice commands and the touch screen. Another possible application for these assistants is assisted therapy. Using artificial vision and ML modeling, they can determine whether the user is performing the exercise or not. The research presented in [10] shows that a stimulus-response model may capture some observed relationships between the patient and the therapist in various tasks of daily life and offers a reasonable model of the interactions between the CA and the patient that can approximate real therapy. Another example is the PHAROS system [11] which is an interactive robotic system that recommends and monitors physical exercises designed for the elderly. It is based on the Pepper robot. The system uses advanced Artificial Intelligence methods to identify human poses in real-time, verifying if they are correct. Moreover, it recommends at a scheduled time activity that each user enjoys and is able to perform.

Not all proposals are robot-shaped. This is the case of iGENDA [12]. This is a cognitive assistant that helps care-receivers and caregivers in the management of their daily living. The main feature of iGENDA is that it tries to promote engagement of the users, including two important modules: (i) a recommendation module that recommends activities that match the user profile and requirements; and (ii) a persuasion module that tries to justify the recommendations by means of arguments. The complete view of the iGENDA assistant can be seen in Figure 2.

As can be seen, there are different proposals that try to improve interaction with humans, mainly from the point of view of enhancing the quality of life of the elderly. However, many of these works are either very expensive commercial robots or are not commercially available. Thus, there is still an important step for this type of solution to become popular.

## CONCLUSIONS

Intelligent Agents seem the perfect way to address the design of cognitive assistants where different devices, each potentially autonomous, must be coordinated to offer more complex services. In recent years, numerous examples of cognitive assistants, designed in the form of intelligent agents, have appeared, offering direct assistance to people with cognitive or physical disabilities. The possibilities of extending existing works are enormous, favoring the interconnection between them to be able to offer more complex and flexible services. Thus, the horizon of research related to CA is completely open.

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